

## **SILICON-STEEL STRUCTURE FOR MOTOR**

### **Field of the invention**

The present invention relates to a silicon-steel structure for motor, especially to a silicon-steel structure for motor, which has compact size, high winding occupancy and simple wiring process.

### **Background of the invention**

As the operating speed of electronic devices such as CPU become higher, more heat is generated and dissipating fan is used to remove excessive heat.

The motor for the dissipating fan has the requirement of high efficiency, low price and compact size.

The prior art DC brushless motor stator can be classified to two categories.

As shown in Fig. 1, the first kind of motor stator is fabricated by stacking plurality layers of silicon-steel plates 10a made of magnetic materials. The silicon-steel plates 10a are surrounded by winding 11a to form a DC brushless motor stator. However, thus formed DC brushless motor stator has following drawbacks:

1. Hard to be compact.
2. Low winding efficiency.
3. The winding process is difficult.

Fig. 2 shows another kind of motor stator. The motor stator comprises an upper silicon-steel plate 21a and a lower silicon-steel plate 21a bridged by an iron sleeve 20a. A plurality of windings (not shown) are wound between the two silicon-steel plates 21a. However, thus formed DC brushless motor stator has following drawbacks:

1. It is hard for the iron sleeve 20a to assemble between the two silicon-steel plates 21a.
2. The parallel between the silicon-steel plates 21a is hard to maintain, the output of the motor is hard to optimize.
- 5       3. There is a gap between the iron sleeve 20a and the two silicon-steel plates 21a, the magnetic circuit is not closed and the rotation speed of the motor is degraded.

### **Summary of the invention**

It is the object of the present invention to provide a silicon-steel structure for motor, which has compact size, high winding occupancy and simple wiring process.

In one aspect of the invention, whole silicon-steel plate is integrally formed. The silicon-steel plate has no conventional problem wherein the iron sleeve is hard to assemble between the two silicon-steel plates, and the parallel between the silicon-steel plates is hard to maintain. Therefore, the motor made by the silicon-steel structure of the present invention has high output power.

In another aspect of the invention, the silicon-steel structure of the present invention is integrally formed to overcome the problem of air gap between prior art iron ring and silicon steel plate. The DC brushless stator formed by the 20 silicon-steel structure of the present invention has closed magnetic circuit to provide satisfactory motor speed.

To achieve above object, the silicon-steel structure for motor comprises a silicon-steel plate made of magnetic material. The silicon-steel plate comprises a main body of rectangular shape when being expanded and a plurality of tooth

portions on top and bottom sides of the main body. The tooth portions are integrally formed on top and bottom sides of the main body and have same pitch. Moreover, the tooth portions on top of the main body are complementary and staggered with the tooth portions on bottom of the main body. The tooth portions are bent vertically with respect to the main body and the main body is rolled to form a cylindrical shape to form a silicon-steel structure for motor.

The various objects and advantages of the present invention will be more readily understood from the following detailed description when read in conjunction with the appended drawing, in which:

**10 Brief description of drawing:**

Fig. 1 shows the perspective view of prior art DC brushless motor stator;

Fig. 2 shows the perspective view of another prior art DC brushless motor stator;

Fig. 3 shows the exploded view of the present inventions;

Fig. 4 shows the perspective view of the present inventions;

Fig. 5 shows the motor stator formed by the silicon-steel structure of the present invention;

Fig. 6 shows the exploded view of a motor r formed by the silicon-steel structure of the present invention; and

Fig. 7 shows the perspective view of another preferred embodiment of the present invention.

**Detailed description of the invention**

Fig. 3 and Fig. 4 show the exploded view and perspective view of the present inventions. The present invention provides a silicon-steel structure for

motor. The silicon-steel structure mainly comprises a silicon-steel plate 10 made of magnetic materials and the size (length, width and thickness) of the silicon-steel plate 10 can be varied according to practical usage.

The silicon-steel plate 10 comprises a main body 11 of rectangular shape  
5 when being expanded and a plurality of tooth portions 12 and 13 on top and bottom sides of the main body 11. The tooth portions 12 and 13 are integrally formed on top and bottom sides of the main body 11 and have same pitch. Moreover, the tooth portions 12 on top of the main body 11 are complementary with the tooth portions 13 on bottom of the main body 11, i.e., the tooth  
10 portions 12 on top of the main body 11 are staggered with the tooth portions 13 on bottom of the main body 11.

To form the silicon-steel structure of the present invention, the tooth portions 12 and 13 are bent vertically with respect to the main body 11.  
Afterward, the main body 11 is rolled to form a cylindrical shape as shown in  
15 Fig. 4.

With reference to Fig. 5, an insulating layer 20 is covered on outer surface of the silicon-steel plate 10 and a winding 30 with predetermined turns is wound around the insulating layer 20, thus forming a DC brushless stator. The thus formed DC brushless stator can be used to fabricate a high-efficiency  
20 motor.

Fig. 6 shows an exploded view of a motor using the DC brushless stator made by the silicon-steel plate 10 of the present invention. The silicon-steel plate 10 is placed atop a printed circuit board (PCB) 40 and a bottom plate 50. A copper sheath 60 with two bearings 70 is arranged within the stator. As

shown in this figure, a blade 80 is arranged atop the DC brushless stator; and a shell 90 and a magnet 100 are arranged on inner wall of the blade 80, wherein the magnet 100 is functioned as outer rotator. The inner circle of the outer rotator has a separation with the outer circle of the inner rotator to form an air gap therebetween. The axis 81 of the blade 80 passes through the bearings 70 of the copper sheath 60, the printed circuit board 40 and the bottom plate 50. A C-shaped ring 110 is used to retain the blade 80 on the bottom plate 50.

The DC brushless stator formed by the silicon-steel structure of the present invention has the advantages of compact size, high winding occupancy and simple winding process. The structure is simplified and the cost is reduced.

The whole silicon-steel plate 10 (including the main body 11 and the tooth portions 12 and 13) is integrally formed. The silicon-steel plate 10 has not conventional problem wherein the iron sleeve is hard to assemble between the two silicon-steel plates, and the parallel between the silicon-steel plates is hard to maintain. Therefore, the motor made by the silicon-steel structure of the present invention has high output power. Moreover, the silicon-steel structure of the present invention is integrally formed to overcome the problem of air gap between prior art iron ring and silicon steel plate. The DC brushless stator formed by the silicon-steel structure of the present invention has closed magnetic circuit to provide satisfactory motor speed.

With reference now to Fig. 7, a plurality of silicon-steel plates 10' are stacked on top and bottom surface of the silicon-steel plate 10 of the present invention for the application of large motor.

Although the present invention has been described with reference to the

preferred embodiment thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have suggested in the foregoing description, and other will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended

- 5 to be embraced within the scope of the invention as defined in the appended  
claims.

Group	Sample	Mean	SD	CV%	Min	Max	Median	Q1	Q3	Range	Skewness	Kurtosis	Outliers
Group A	Sample 1	10.5	2.1	20.0	6.0	14.0	11.0	9.0	12.0	8.0	-0.2	3.0	No
Group A	Sample 2	12.0	1.8	15.0	8.0	15.0	13.0	11.0	14.0	7.0	-0.1	2.5	No
Group A	Sample 3	11.5	2.3	20.0	7.0	14.0	10.0	8.0	13.0	7.0	-0.3	3.0	No
Group B	Sample 4	13.0	1.5	11.5	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group B	Sample 5	14.0	1.7	12.0	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.5	No
Group B	Sample 6	12.5	2.0	16.0	8.0	15.0	10.0	8.0	14.0	7.0	-0.4	3.0	No
Group C	Sample 7	11.0	1.9	17.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group C	Sample 8	10.0	2.2	22.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group C	Sample 9	12.0	1.6	13.0	9.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group D	Sample 10	15.0	1.4	9.3	11.0	18.0	14.0	12.0	16.0	7.0	-0.1	2.0	No
Group D	Sample 11	16.0	1.3	8.1	12.0	19.0	15.0	13.0	17.0	7.0	-0.2	2.0	No
Group D	Sample 12	14.0	1.5	10.0	10.0	17.0	12.0	10.0	15.0	7.0	-0.1	2.5	No
Group E	Sample 13	10.0	1.7	17.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group E	Sample 14	11.0	1.9	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group E	Sample 15	12.0	1.6	13.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group F	Sample 16	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group F	Sample 17	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group F	Sample 18	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group G	Sample 19	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group G	Sample 20	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group G	Sample 21	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group H	Sample 22	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group H	Sample 23	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group H	Sample 24	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group I	Sample 25	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group I	Sample 26	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group I	Sample 27	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group J	Sample 28	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group J	Sample 29	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group J	Sample 30	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group K	Sample 31	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group K	Sample 32	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group K	Sample 33	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group L	Sample 34	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group L	Sample 35	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group L	Sample 36	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group M	Sample 37	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group M	Sample 38	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group M	Sample 39	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group N	Sample 40	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group N	Sample 41	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group N	Sample 42	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group O	Sample 43	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group O	Sample 44	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group O	Sample 45	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group P	Sample 46	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group P	Sample 47	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group P	Sample 48	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group Q	Sample 49	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group Q	Sample 50	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group Q	Sample 51	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group R	Sample 52	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group R	Sample 53	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group R	Sample 54	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group S	Sample 55	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group S	Sample 56	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group S	Sample 57	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group T	Sample 58	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group T	Sample 59	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group T	Sample 60	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group U	Sample 61	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group U	Sample 62	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group U	Sample 63	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group V	Sample 64	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group V	Sample 65	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group V	Sample 66	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group W	Sample 67	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group W	Sample 68	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group W	Sample 69	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group X	Sample 70	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group X	Sample 71	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group X	Sample 72	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group Y	Sample 73	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group Y	Sample 74	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group Y	Sample 75	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group Z	Sample 76	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group Z	Sample 77	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group Z	Sample 78	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group AA	Sample 79	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group AA	Sample 80	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group AA	Sample 81	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group BB	Sample 82	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group BB	Sample 83	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group BB	Sample 84	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group CC	Sample 85	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group CC	Sample 86	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group CC	Sample 87	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group DD	Sample 88	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group DD	Sample 89	14.0	1.1	7.9	10.0	17.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group DD	Sample 90	12.0	1.3	11.5	8.0	15.0	10.0	8.0	13.0	7.0	-0.1	2.5	No
Group EE	Sample 91	11.0	1.5	13.6	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group EE	Sample 92	10.0	1.7	17.0	7.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group EE	Sample 93	12.0	1.4	11.7	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group FF	Sample 94	14.0	1.0	7.1	11.0	17.0	14.0	12.0	15.0	7.0	-0.1	2.0	No
Group FF	Sample 95	15.0	0.9	6.0	12.0	18.0	15.0	13.0	16.0	7.0	-0.2	2.0	No
Group FF	Sample 96	13.0	1.1	8.5	10.0	16.0	12.0	10.0	14.0	7.0	-0.1	2.5	No
Group GG	Sample 97	10.0	1.6	16.0	6.0	13.0	8.0	6.0	11.0	7.0	-0.3	3.0	No
Group GG	Sample 98	11.0	1.8	18.0	7.0	14.0	9.0	7.0	12.0	7.0	-0.1	2.0	No
Group GG	Sample 99	12.0	1.5	12.0	8.0	15.0	10.0	8.0	13.0	7.0	-0.2	2.5	No
Group HH	Sample 100	13.0	1.2	9.2	9.0	16.0	14.0	12.0	15.0	7.0	-0.1	2.0	No